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(54) **Governor**

Fliehkraftdrehzahlregler

Régulateur centrifuge

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Description

[0001] This invention relates to a governor for use in controlling the rate at which fuel is supplied to a fuel pump, and thus for use in controlling the operation of an engine of the compression ignition type.

[0002] A governor for use with a diesel engine of an alternator and generator set typically comprises a centrifugal weight mechanism arranged to rotate at a speed associated with engine speed and to act upon a spring biased lever, the lever being coupled to a fuel metering valve such that movement of the lever is transmitted to the valve to adjust the setting of the valve. In particular, the governor is arranged such that in the event that the load on the engine changes, a corresponding change in the fuelling of the engine is made to control the engine in such a manner that it operates at a substantially constant speed.

[0003] It is desirable to be able to adjust the governor to permit control over the change in engine speed which must occur in order for the metering valve to move between its fully open and closed positions. Such adjustment is known as "droop" adjustment or control and is desirable as it allows the governor to be controlled to compensate for wear and for variations in the output of governors of identical nominal specifications. Droop control may also be used to improve the stability of the system, for example to limit engine speed oscillations following a rapid change in load.

[0004] US3460479 describes a known governor having a valve member which is angularly moveable by a governor arm and axially moveable in accordance with the speed of the engine. The axial position of said valve member is adjusted by a screw.

[0005] According to the invention, there is provided a governor comprising a centrifugal weight mechanism coupled to an angularly adjustable metering valve member. The metering valve member is arranged in a flow path between a transfer pump and an inlet of a high pressure fuel pump and the centrifugal weight mechanism is operable to adjust the angular position of the metering valve member so as to vary the rate of fuel flow delivered by the transfer pump to the inlet of the high pressure fuel pump. From a first aspect, the governor is provided with an adjustment screw, for adjusting the axial position of the metering valve member to permit control over the change in engine speed which must occur in order for the metering valve member to move between its fully open and fully closed positions, the adjustment screw being located substantially coaxial with the metering valve member, and above the metering valve member.

[0006] From a second aspect, the governor is provided with a wedge member for adjusting the axial position of the metering valve member to permit control over the change in engine speed which must occur in order for the metering valve member to move between its fully open and fully closed positions. The wedge member is slidable upon a ramped surface whereby a change in

position of the wedge member relative to the ramped surface causes a change in the axial position of the metering valve member.

[0007] The invention will further be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a governor in accordance with an embodiment of the invention;

Figures 2 and 3 are diagrams illustrating the operation of the embodiment of Figure 1; and

Figure 4 is a schematic view of a part of a governor in accordance with an alternative embodiment.

[0008] The accompanying drawings illustrate a governor which comprises a centrifugal weight mechanism 10 mounted upon a shaft 11 which is arranged to rotate at a speed associated with the operating speed of an associated engine, for example cam shaft or crank shaft speed. The shaft 11 carries a cage 12, the cage 12 being rotatable with the shaft 11. A plurality of weights 13 are pivotally mounted within the cage 12. Each of the weights 13 includes a projection 14 which is engageable with an end surface of a sleeve 15, the sleeve 15 being axially adjustable relative to the shaft 11. The sleeve 15 abuts a lever 16, the lever 16 being pivotable about an arm 17. A governor spring 18 is secured to the lever 16, the governor spring 18 engaging a throttle member 19 which is adjustable to vary the preload applied to the spring 18.

[0009] In use, when the engine is operating at a relatively low speed, and hence the shaft 11 rotates at a relatively low speed, the action of the governor spring 18 upon the lever 16 applies a force to the sleeve 15 urging the sleeve 15 towards the left in the orientation illustrated in Figure 1, the engagement between the sleeve 15 and the weights 13 ensuring that the weights 13 occupy a radially inner position. As the engine speed increases, the centrifugal force resulting from the increased speed of rotation of the shaft 11 urges the weights 13 to pivot towards radially outer positions, such movement causing translation of the sleeve 15, and pivotal movement of the lever 16 against the action of the governor spring 18.

[0010] The lever 16 is coupled through a conventional coupling arrangement 20 to a crank 21 mounted upon an upper end region of a metering valve member 22 which is angularly adjustable within a bore 23. The bore 23 is arranged to be supplied with fuel, at relatively low pressure, by a transfer pump which is conveniently operated at a speed associated with engine speed.

[0011] The metering valve member 22 is provided, at its lower end, with a recess 24 which is registrable with an outlet 25 such that, depending upon the angular position of the metering valve member 22, fuel from the transfer pump can be supplied through the bore 23 and recess 24 to the outlet 25. The outlet 25 communicates with an inlet of a high pressure fuel pump which is used

to supply fuel at high pressure to injectors associated with each cylinder of the engine. The high pressure fuel pump may, for example, take the form of a rotary distributor pump. However, it will be appreciated that the invention is also applicable to governors for use with fuel systems including high pressure fuel pumps of other types.

[0012] The governor of Figure 1 further comprises a droop adjustment arrangement which comprises a wedge member 26 slidable upon a ramped surface of a member 27, an adjustment screw being provided to adjust the position of the wedge member 26. The wedge member 26 abuts the upper end of the metering valve member 22 such that adjustment of the adjustment screw 28 to cause a change in the position of the wedge member 26 causes the metering valve member 22 to move axially relative to the bore 23.

[0013] Figures 2 and 3 illustrate the effect of adjusting the axial position of the metering valve member 22. In Figures 2 and 3, the shaded region 29 denotes the region of overlap between the end of the outlet 25 and the recess 24 provided in the metering valve member 22 when the valve member 22 occupies a fully open position. The fully open position may be defined or determined using, for example, scroll or catch plates or other stops for limiting angular adjustment of the valve member 22. In both Figure 2 and Figure 3, the region of overlap relates to a flow area of, for example, 2mm². In the arrangement of Figure 2, the dashed line indicates the position of the recess 24 when the metering valve member 22 is moved to a closed position in which there is no overlap between the recess 24 and the outlet 25. The movement of the metering valve member 22 between these positions is denoted by arrow X. It will be appreciated, however, that the movement of the metering valve member 22 is an angular movement, and not a linear movement.

[0014] Figure 3 illustrates the movement of the metering valve member 22 between its fully open position and closed positions where the axial position of the metering valve member 22 has been shifted through a distance Y. As illustrated in Figure 3, the degree by which the valve member 22 must move in order to move between its fully open and fully closed positions, denoted by arrow Z in Figure 3 is significantly greater than the corresponding distance, distance X, shown in Figure 2.

[0015] Although in the accompanying figures the outlet 25 is shown to have a cross section of circular form, it will be appreciated that the outlet 25 may take an alternative form. For example, it may be desirable to provide an outlet 25 of rectangular form. The shape of the outlet 25 determines the sensitivity of the metering valve arrangement and the shape of the outlet can therefore be chosen to provide the sensitivity required for the particular application of the governor.

[0016] As the metering valve member 22 is coupled to the centrifugal weight mechanism 10, it will be appreciated that the angle through which the metering valve member 22 is moved is related to the change in engine speed. It will therefore be appreciated that when the valve

member 22 occupies the axial position shown in Figure 2, the valve member 22 moves between a fully open and a fully closed position as a result of a relatively small change in engine speed, the arrangement of Figure 3 in which the metering valve member 22 occupies a lower axial position requiring the engine speed to vary by a greater amount to cause the same change in fuelling level.

[0017] In use, with the engine operating at a given speed against a given load, the speed being determined by the setting of the throttle member 19, if the load falls, then the engine speed will increase. The increase in engine speed causes the weights 13 to move radially outward, this movement being transmitted to the lever 16, the lever 16 moving against the action of the spring 18. The movement of the lever 16 is transmitted to the metering valve member 22, moving the valve member 22 to a position in which the rate of fuel supply to the high pressure fuel pump is reduced. As a result of the reduction in fuelling, the engine speed will fall, the governor returning the engine to substantially its original speed. Similarly, if the load on the engine increases, the governor changes the engine fuelling level to correct for the change in load.

[0018] It will be appreciated that, if in use, as a result of wear or for system stability reasons, or for any other reason, the droop of the governor changes or needs changing, then by appropriate adjustment of the adjustment screw 28, the axial position of the metering valve member 22 can be adjusted to achieve the desired level of droop. As a result, the operation of the governor to control the engine so that the engine operates at a substantially constant speed can be improved.

[0019] Referring to Figure 4, in an alternative embodiment of the invention the adjustment of the axial position of the metering valve member 22 is achieved by means of an adjustment screw 30 which is arranged substantially vertically above the metering valve member 22, in the orientation shown in Figure 1. The lowermost end of the adjustment screw 30 is provided with a groove which cooperates with an upper arm 32a of an intermediate bridge member 32. The bridge member 32 also includes a lower arm 32b, a surface of the lower arm 32b being in abutment with an upper surface of a spigot 22a forming part of the metering valve member 22. In this embodiment of the invention, the axial position of the metering valve member 22 can be adjusted by adjusting the position of the adjustment screw 30 along an axis which is substantially coaxial with the axis of the metering valve member 22, adjustment of the position of the adjustment screw 30 being transmitted to the metering valve member 22 through the bridge member 32. The provision of the bridge member 32 permits accommodation of a part of the throttle linkage 34 and a control arm (not shown) for the metering valve member 22.

[0020] The bridge member 32 also includes a leg portion 32c, the leg portion 32c being engageable with a surface 36 associated with a housing 38 to limit the extent

of movement of the bridge member 32 along the axis of the metering valve member 22. As movement of the bridge member 32 is limited in this way, the position of the metering valve member 22 is prevented from being adjusted to such an extent that the metering valve is driven too far into the housing 38 causing it to jam, thereby causing a hazard to the correct operation of the governor. By using the adjustment screw 30 to adjust the position of the metering valve member 22 in this way, it will be appreciated that the need for the wedge member 26 and the ramped surface 27, as shown in Figures 1 to 3, is removed.

Claims

1. A governor comprising a centrifugal weight mechanism (10) coupled to an angularly adjustable metering valve member (22) which is arranged in a flow path between a transfer pump and an inlet of a high pressure fuel pump, the centrifugal weight mechanism (10) being operable to adjust the angular position of the metering valve member (22) so as to vary the rate of fuel flow delivered by the transfer pump to the inlet of the high pressure fuel pump, **characterised in that** the governor includes an adjustment screw (30), for adjusting the axial position of the metering valve member (22) to permit control over the change in engine speed which must occur in order for the metering valve member (22) to move between its fully open and fully closed positions, the adjustment screw (30) being located substantially coaxial with the metering valve member (22), and above the metering valve member.
2. The governor as claimed in Claim 1, wherein the adjustment screw (30) acts on a bridge member (32), the bridge member (32) acting on a surface associated with the metering valve member (22) such that adjustment of the adjustment screw (30) causes the axial position of the metering valve member (22) to be adjusted.
3. The governor as claimed in Claim 2, wherein the bridge member (32) includes a leg portion (32c) which serves to limit the extent of adjustment of the axial position of the metering valve member (22).
4. A governor comprising a centrifugal weight mechanism (10) coupled to an angularly adjustable metering valve member (22) which is arranged in a flow path between a transfer pump and an inlet of a high pressure fuel pump, the centrifugal weight mechanism (10) being operable to adjust the angular position of the metering valve member (22) so as to vary the rate of fuel flow delivered by the transfer pump to the inlet of the high pressure fuel pump, **characterised in that** the governor includes a wedge mem-

ber (26) for adjusting the axial position of the metering valve member (22) to permit control over the change in engine speed which must occur in order for the metering valve member (22) to move between its fully open and fully closed positions, the wedge member (26) being slidable upon a ramped surface whereby a change in position of the wedge member (26) relative to the ramped surface causes a change in the axial position of the metering valve member (22).

5. The governor as claimed in Claim 4, wherein the wedge member (26) is in abutment with an end of the metering valve member (22).
6. The governor as claimed in Claim 4 or Claim 5, wherein the metering valve member (22) is axially movable within a bore (23).
7. The governor as claimed in any of Claims 4 to 6, wherein the position of the wedge member (26) is adjustable by means of an adjustment screw (28).
8. The governor as claimed in any of Claims 1 to 7, wherein the metering valve member (22) is provided with a recess (24) which is registerable with an outlet (25) to control the fuelling level through the outlet (25), in use.
9. The governor as claimed in Claim 8, wherein the metering valve member (22) is angularly movable between an open position, in which the recess (24) and the outlet (25) overlap to provide a maximum fuelling level, and a closed position in which there is substantially no overlap between the recess (24) and the outlet (25).
10. The governor as claimed in Claim 9, and further comprising stop means for limiting angular adjustment of the metering valve member (22) to determine the maximum fuelling level.
11. The governor as claimed in Claim 10, wherein the stop means take the form of catch plates or scroll plates.

Patentansprüche

1. (Drehzahl-)Regler, umfassend einen Fliehgewicht-Mechanismus (10), der an ein bezüglich seiner Winkelstellung einstellbares Dosierventilelement (22) gekoppelt ist, das seinerseits in einem Durchflussweg zwischen einer Transferpumpe und einem Einlass einer Hochdruckkraftstoffpumpe angeordnet ist, wobei der Fliehgewicht-Mechanismus (10) betätigt werden kann, um die Winkelstellung des Dosierventilelements (22) einzustellen, um damit die

- Durchflussrate bzw. -menge an Kraftstoff zu verändern, die von der Transferpumpe zu dem Einlass der Hochdruckkraftstoffpumpe überführt wird, **dadurch gekennzeichnet, dass** der (Drehzahl-)Regler eine Stellschraube (30) zum Einstellen bzw. Anpassen der axialen Position des Dosierventilelements (22) umfasst, um die Änderung der Motordrehzahl kontrollieren bzw. steuern zu können, die auftreten muss, damit sich das Dosierventilelement (22) zwischen seiner vollständig offenen und seiner vollständig geschlossenen Stellung bewegt, wobei die Stellschraube (30) im Wesentlichen koaxial zu dem Dosierventilelement (22) und oberhalb des Dosierventilelements angeordnet ist.
2. (Drehzahl-)Regler wie in Anspruch 1 beansprucht, worin die Stellschraube (30) auf ein Brückenelement (32) einwirkt, wobei das Brückenelement (32) auf eine mit dem Dosierventilelement (22) verbundene oder diesem zugeordnete Außenfläche einwirkt, derart, dass die Einstellung bzw. Anpassung der Stellschraube (30) zur Folge hat, dass die axiale Position des Dosierventilelements (22) eingestellt bzw. angepasst wird.
 3. (Drehzahl-)Regler wie in Anspruch 2 beansprucht, worin das Brückenelement (32) einen Schenkelbereich (32c) umfasst, der dazu dient, das Ausmaß der Einstellung bzw. der Anpassung der axialen Position des Dosierventilelements (22) zu begrenzen.
 4. (Drehzahl-)Regler, umfassend einen Fliehgewicht-Mechanismus (10), der an ein bezüglich seiner Winkelstellung einstellbares Dosierventilelement (22) gekoppelt ist, das seinerseits in einem Durchflussweg zwischen einer Transferpumpe und einem Einlass einer Hochdruckkraftstoffpumpe angeordnet ist, wobei der Fliehgewicht-Mechanismus (10) betätigt werden kann, um die Winkelstellung des Dosierventilelements (22) einzustellen, um damit die Durchflussrate bzw. -menge an Kraftstoff zu verändern, die von der Transferpumpe zu dem Einlass der Hochdruckkraftstoffpumpe überführt wird, **dadurch gekennzeichnet, dass** der (Drehzahl-)Regler ein keilförmiges Element (26) zum Einstellen bzw. Anpassen der axialen Position des Dosierventilelements (22) umfasst, um die Änderung der Motordrehzahl kontrollieren bzw. steuern zu können, die auftreten muss, damit sich das Dosierventilelement (22) zwischen seiner vollständig offenen und seiner vollständig geschlossenen Stellung bewegt, wobei das keilförmige Element (26) an einer bzw. über eine geneigte Oberfläche gleiten kann, derart, dass eine Veränderung der Stellung des keilförmigen Elements (26) im Verhältnis zur geneigten Oberfläche eine Veränderung der axialen Position des Dosierventilelements (22) zur Folge hat.
 5. (Drehzahl-)Regler wie in Anspruch 4 beansprucht, worin sich das keilförmige Element (26) in Anlage mit einem Ende des Dosierventilelements (22) befindet.
 6. (Drehzahl-)Regler wie in Anspruch 4 oder Anspruch 5 beansprucht, worin das Dosierventilelement (22) innerhalb einer Bohrung (23) axial bewegbar ist.
 7. (Drehzahl-)Regler wie in einem der Ansprüche 4 bis 6 beansprucht, worin die Stellung des keilförmigen Elements (26) mit Hilfe einer Stellschraube (28) eingestellt bzw. angepasst werden kann.
 8. (Drehzahl-)Regler wie in einem der Ansprüche 1 bis 7 beansprucht, worin das Dosierventilelement (22) mit einer Vertiefung oder Ausnehmung (24) ausgestattet ist, die über einen Auslass (25) gebracht werden bzw. mit diesem fluchten kann, um während des Betriebs das Ausmaß der Kraftstoffzuführung durch den Auslass (25) zu steuern.
 9. (Drehzahl-)Regler wie in Anspruch 8 beansprucht, worin das Dosierventilelement (22) zwischen einer offenen Stellung, in welcher die Vertiefung oder Ausnehmung (24) und der Auslass (25) so überlappen bzw. übereinander zu liegen kommen, dass eine maximale Kraftstoffzuführung gewährleistet ist, und einer geschlossenen Stellung, in welcher es im Wesentlichen keine Überlappung zwischen der Ausnehmung bzw. Vertiefung (24) und dem Auslass (25) gibt, bezüglich seiner Winkelstellung bewegbar ist.
 10. (Drehzahl-)Regler wie in Anspruch 9 beansprucht und weiterhin umfassend ein Anschlagmittel zum Beschränken der Einstellung bzw. Anpassung des Dosierventilelements (22) bezüglich seiner Winkelstellung, um die maximale Kraftstoffzuführung festzulegen.
 11. (Drehzahl-)Regler wie in Anspruch 10 beansprucht, worin das Anschlagmittel die Gestalt von Mitnehmerscheiben oder -blechen oder Spiralblechen (scroll plates) besitzt.

Revendications

1. Régulateur comprenant un mécanisme de masse centrifuge (10) couplé à un élément de soupape de dosage réglable de façon angulaire (22) qui est agencé dans un circuit d'écoulement entre une pompe de transfert et une entrée d'une pompe de carburant à haute pression, le mécanisme de masse centrifuge (10) étant utilisable pour régler la position angulaire de l'élément de soupape de dosage (22) de sorte à modifier la vitesse de l'écoulement de carburant délivré par la pompe de transfert à l'entrée

- de la pompe de carburant à haute pression, **caractérisé en ce que** le régulateur comprend une vis de réglage (30), pour régler la position axiale de l'élément de soupape de dosage (22) pour permettre de contrôler le changement de vitesse du moteur qui doit se produire afin que l'élément de soupape de dosage (22) se déplace entre ses positions complètement ouverte et complètement fermée, la vis de réglage (30) étant située de façon sensiblement coaxiale à l'élément de soupape de dosage (22), et au-dessus de l'élément de soupape de dosage.
2. Régulateur selon la revendication 1, dans lequel la vis de réglage (30) agit sur un élément de pont (32), l'élément de pont (32) agissant sur une surface associée à l'élément de soupape de dosage (22) de telle sorte que le réglage de la vis de réglage (30) entraîne le réglage de la position axiale de l'élément de soupape de dosage (22).
 3. Régulateur selon la revendication 2, dans lequel l'élément de pont (32) comprend une partie de jambe (32c) qui sert à limiter l'étendue du réglage de la position axiale de l'élément de soupape de dosage (22).
 4. Régulateur comprenant un mécanisme de masse centrifuge (10) couplé à un élément de soupape de dosage réglable de façon angulaire (22) qui est agencé dans un circuit d'écoulement entre une pompe de transfert et une entrée d'une pompe de carburant haute pression, le mécanisme de masse centrifuge (10) étant utilisable pour régler la position angulaire de l'élément de soupape de dosage (22) de sorte à modifier la vitesse d'écoulement de carburant délivré par la pompe de transfert vers l'entrée de la pompe de carburant haute pression, **caractérisé en ce que** le régulateur comprend un élément de cale (26) pour régler la position axiale de l'élément de soupape de dosage (22) pour permettre de contrôler le changement de vitesse du moteur qui doit se produire afin que l'élément de soupape de dosage (22) se déplace entre ses positions complètement ouverte et complètement fermée, l'élément de cale (26) pouvant coulisser sur une surface inclinée moyennant quoi un changement de position de l'élément de cale (26) par rapport à la surface inclinée entraîne un changement de la position axiale de l'élément de soupape de dosage (22).
 5. Régulateur selon la revendication 4, dans lequel l'élément de cale (26) est en butée avec une extrémité de l'élément de soupape de dosage (22).
 6. Régulateur selon la revendication 4 ou la revendication 5, dans lequel l'élément de soupape de dosage (22) est mobile axialement à l'intérieur d'un alésage (23).
 7. Régulateur selon l'une quelconque des revendications 4 à 6, dans lequel la position de l'élément de cale (26) est réglable au moyen d'une vis de réglage (28).
 8. Régulateur selon l'une quelconque des revendications 1 à 7, dans lequel l'élément de soupape de dosage (22) est pourvu d'un évidement (24) qui est repérable avec un orifice de sortie (25) pour contrôler le niveau de remplissage en carburant à travers l'orifice de sortie (25), pendant l'utilisation.
 9. Régulateur selon la revendication 8, dans lequel l'élément de soupape de dosage (22) est mobile de façon angulaire entre une position ouverte, dans laquelle l'évidement (24) et l'orifice de sortie (25) se chevauchent pour assurer un niveau de remplissage en carburant maximum ; et une position fermée dans laquelle il n'existe sensiblement aucun chevauchement entre l'évidement (24) et l'orifice de sortie (25).
 10. Régulateur selon la revendication 9, comprenant en outre des moyens d'arrêt pour limiter le réglage angulaire de l'élément de soupape de dosage (22) afin de déterminer le niveau de remplissage en carburant maximum.
 11. Régulateur selon la revendication 10, dans lequel les moyens d'arrêt prennent la forme de plaques d'arrêt ou de plaques spiralées.



